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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/642,959	08/21/2000	Bryan K. Choo	E0778	7850

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EXAMINER

HESELDTINE, RYAN J

ART UNIT

PAPER NUMBER

2623

DATE MAILED: 05/19/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/642,959

Applicant(s)

CHOO ET AL.

Examiner

Ryan J Hesseltine

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 22 March 2004.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-13 and 19-26 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-13 and 19-26 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

JINGGEWU
PRIMARY EXAMINER

DETAILED ACTION

Response to Arguments

1. Applicant's arguments filed March 22, 2004 have been fully considered but they are not persuasive.
2. On page 2, fourth paragraph (indented in bold) with respect to claims 1, 2, 6, 9, 10, 13, 19-21, and 24-26, applicant states, "The combination of Garza et al. and Le et al. is improper because no motivation exists for the combination." The examiner respectfully disagrees. In response to applicant's argument that there is no suggestion to combine the references, the examiner recognizes that obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. See *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988) and *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992). In this case, the motivation to combine can be found in Le et al. at column 2, line 37-45 where it states that an optical proximity corrected design is checked to determine if it will create the desired image using a simple process for checking the mask layout so that design changes can be made if necessary.
3. On page 2, second to last paragraph, applicant states, "Garza et al. is not concerned with OPC designs, but instead is directed toward simulation software to emulate a given lithography process." The examiner agrees with this assertion as it was stated on page 7 of applicant's last response filed October 24, 2003, which prompted the new grounds of rejection in view of Le.

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4. On page 3, second paragraph, applicant states, "Le et al. stands in stark contrast to Garza et al. in that Le et al. focus on the content of the input data in a simulation process and ignore the simulation mechanism that operates on the input data." The examiner respectfully disagrees. While Garza attempts to improve a mask simulating process, Le uses a simulation program to aid in the checking (evaluating) of mask layout designs (column 2, line 37-45), which is the same problem applicant is trying to solve (see applicant's specification page 4, line 27-page 5, line 2). The examiner believes that Garza and Le work hand in hand since Garza improves a simulating process, which could then be used by Le to evaluate the layout design. The examiner would like to point out that Le also discloses that an analysis system is configured to determine a first image (original binary mask layout) corresponding to at least one segment of a feature, determine a second image (simulated wafer image data) to facilitate analysis of the first image, and evaluate OPC designs based upon comparisons of the first and second images (column 4, line 18-33), which further shows that Garza and Le are fully combinable.

5. On page 5, second paragraph with respect to claim 4, applicant states, "Neither the primary references nor Sugawara teach or suggest a second image determined from a corresponding segment of another feature from a different mask fabrication process." The examiner respectfully disagrees. The examiner would like to point out that neither claim 4 nor claim 1, from which claim 4 depends, define what is meant by a "different mask fabrication process" and, therefore, has been given the broadest most reasonable interpretation. The cited portions of the specification (page 5, line 13-16; page 9, line 24-28) provide no further explanation. The examiner believes that the cited portion of Sugawara (column 10, line 34-59) discloses the claimed "different mask fabrication process" since the shapes of different

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evaluation patterns formed on a photomask are evaluated (see Figures 2A-2E). Sugawara further discusses photomask manufacturing (fabrication) processes and exposure processes with respect to different kinds of latitude such as mask-line-width, exposure, and depth of focus as tolerable errors in mask line width (column 2, line 37-49; column 3, line 50-55; column 5, line 12-41; column 6, line 25-49; column 7, line 13-26; column 30, line 43-59).

6. Since applicant has not discussed the rejections of any other claim (namely claims 3, 5, 7, 8, 11, 12, 14-18, 22, and 23), it has been assumed that applicant agrees with the grounds of rejection set forth below in view of Leroux, Kenan, and Garza '233.

Claim Rejections - 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

8. Claims 1, 2, 6, 9, 10, 13, 19-21, and 24-26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Garza et al. (USPN 6,078,738, previously cited), hereafter Garza, and further in view of Le et al. (USPN 5,801,954, previously cited), hereafter Le.

9. Regarding claims 1, 19, and 20, Garza discloses a system and method for evaluating (comparing differences in) optical proximity corrected (OPC) design simulations (column 3, line 17-26), comprising: means (an analysis system) for performing measurements (e.g. line width) relating to at least one segment (portion) of a feature (column 5, line 52-63); means for determining (wherein the analysis system is configured to determine) a first image (SEM image digitized to produce second database) corresponding to the at least one segment of the feature

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(column 9, line 14-21); means for determining (the analysis system determines) a second image (simulated aerial image digitized to produce a first database) to facilitate analysis of the first image (column 9, line 3-14); and means for evaluating (the analysis system evaluates) OPC design simulations based upon comparisons of the first and second images (column 9, line 24-37).

10. Garza does not explicitly disclose that the optical proximity corrected (OPC) designs themselves are evaluated; rather, Garza discloses a method of simulating a masking process in which the simulations are made to correspond to the actual pattern produced by the mask. Le discloses a process for designing and checking a mask layout (column 3, line 52-65) wherein, similar to Garza, an aerial image of the mask layout is calculated using simulation software and compared to the binary mask layout design, but, different from Garza, if there are differences between the two, a modified mask layout (design) is generated and a new simulated aerial image is created and the two are again compared (column 4, line 18-34). This process is repeated until the simulated wafer images correlate with the binary mask layout within the design rules. It would have been obvious to one of ordinary skill in the art at the time the invention was made to evaluate optical proximity corrected designs as taught by Le in order to check the optical proximity corrected design to determine if it will create the desired image using a simple process for checking the mask layout so that changes can be made if necessary (column 2, line 37-45).

11. Regarding claim 2, Garza discloses that the analysis system is a CD-SEM (critical dimension scanning electron microscope) system (column 1, line 55-66; column 4, line 5-9).

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12. Regarding claims 6 and 24, Garza discloses that the second image (simulated aerial image) is determined from a corresponding segment of an ideal (desired) feature (column 3, line 8-14).

13. Regarding claim 9, Garza discloses that the comparison of the first and second image is based upon digital (both images are digitized) subtraction (error database indicative of differences; column 4, line 55-61).

14. Regarding claim 10, Garza discloses that the comparison of the first and second image provides information relating to corner rounding, end rounding (shortening of terminal portions; column 5, line 55-60), or structure pull-back (shrinking of line width; column 6, line 30-32).

15. Regarding claims 13 and 21, Garza discloses that the measurements (image) relating to the at least one segment of the feature is determined from a sequence of measurements that are recorded over a distance (discrepancies shown as displacement from idealized pattern along pattern edges; Figure 3; column 6, line 23-32).

16. Regarding claim 25, Garza discloses that the evaluation of the first and second image is determined from comparisons of the first image and the ideal feature (column 9, line 24-37).

17. Regarding claim 26, Garza discloses a CD-SEM system for evaluating (comparing differences in) optical proximity corrected (OPC) designs (column 3, line 17-26; see above discussion of claims 1, 19, and 20 with respect to Le), comprising: a processing system for performing measurements (scanning electron microscope image) relating to at least one segment (portion) of a feature (column 9, line 14-19); wherein the measurements are taken as a sequence of measurements over a distance (discrepancies shown as displacement from idealized pattern along pattern edges; Figure 3; column 6, line 23-32), the processing system is configured to

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determine a first image (SEM image digitized to produce second database) for the at least one segment of the feature based on the measurements (column 9, line 14-21); the processing system determines a second image (simulated aerial image digitized to produce a first database) to facilitate analysis of the first image (column 9, line 3-14); the processing system evaluates OPC designs based upon comparisons of the first and second images (column 9, line 24-37; see above discussion of claims 1, 19, and 20 with respect to Le).

18. Claims 3 and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Garza in view of Le as applied to claims 1 and 20 above, and further in view of Leroux et al. (USPN 5,962,173, previously cited), hereafter Leroux.

19. Regarding claims 3 and 22, Garza does not disclose that the second image is determined from a corresponding segment of another feature having a different OPC design. Leroux discloses a method for measuring the effectiveness of optical proximity corrections wherein several test patterns, each with a different form of optical proximity correction, can be lithographed onto a single wafer for comparative review of the different correction schemes (abstract; column 7, line 16-19 and 38-46). It would have been obvious to one of ordinary skill in the art at the time the invention was made to compare two images of corresponding features having a different OPC design as taught by Leroux in order to compare the different correction schemes to determine which more accurately approximates the ideal pattern (column 3, line 1-14).

20. Claim 4 is rejected under 35 U.S.C. 103(a) as being unpatentable over Garza in view of Le as applied to claim 1 above, and further in view of Sugawara (USPN 5,698,346, previously cited).

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21. Regarding claim 4, Garza does not disclose that the second image is determined from a corresponding segment of another feature having a different mask fabrication process. Sugawara discloses a photomask pattern shape evaluation method wherein the second image is determined from a corresponding segment of another feature having a different mask fabrication (manufacturing) process (exposure latitude, depth of focus, etc.; column 10, line 34-59). It would have been obvious to one of ordinary skill in the art at the time the invention was made to determine the second image from a corresponding segment of another feature having a different mask fabrication process as taught by Suguwara in order to adjust the exposure latitude, depth of focus, etc. to correspond with the other feature (column 2, line 11-27; column 5, line 12-35).

22. Claims 5, 7, and 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Garza in view of Le as applied to claims 1, 6, and 20 above, and further in view of Kenan et al. (USPN 6,268,093, previously cited), hereafter Kenan.

23. Regarding claims 5, 7, and 23, Garza does not disclose that the evaluation of OPC designs is determined by graphical comparisons of the first and second images. Kenan discloses a method for reticle inspection using aerial imaging wherein the system uses the results of the line width measurements for individual dies of the reticle to generate a map of the line width variations (comparisons) for the entire reticle which is then displayed to the user in graphical format (column 11, line 59-65). It would have been obvious to one of ordinary skill in the art at the time the invention was made to determine the evaluation of OPC designs graphically as taught by Kenan in order to provide a useful method for visualizing how the amount of variation in line width changes from die-to-die on the reticle (column 11, line 63-column 12, line 3).

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24. Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over Garza in view of Le as applied to claim 1 above, and further in view of Garza et al. (USPN 5,723,233, previously cited), hereafter Garza '233.

25. Regarding claim 8, Garza does not disclose that the evaluation of OPC designs is determined by a regression analysis. Garza '233 discloses an optical proximity correction method and apparatus wherein a non-linear mathematical expression generated by curve fitting data (regression) ascertains the degree of correction required (evaluation) for patterns having critical dimensions in a non-linear domain (column 6, line 6-12). It would have been obvious to one of ordinary skill in the art at the time the invention was made to evaluate OPC designs using non-linear mathematical expressions generated by curve fitting data as taught by Garza '233 in order to accurately depict reticle designs having very small critical dimensions (column 4, line 3-20; column 5, line 66-column 6, line 6).

26. Claims 11 and 12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Garza in view of Le as applied to claim 1 above.

27. Regarding claim 11, Garza discloses that the simulator 140 comprises a computer 141 including an input device for receiving the input information (column 6, line 61-column 7, line 5), but does not disclose that the at least one segment is determined manually. It would have been obvious to one of ordinary skill in the art at the time the invention was made to allow the at least one segment to be determined manually for example using an input device as taught by Garza in order to allow a user or operator to inspect a desired area of a semiconductor substrate (column 9, line 37-48).

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28. Regarding claim 12, Garza discloses that the first and second image are aligned with respect to one another using alignment marks to facilitate comparison of the images (column 9, line 21-26), but does not disclose that the two images are aligned by minimizing a sum of the squares distance between the respective images. The examiner takes Official Notice that aligning two images by minimizing a sum of the squares distance between the respective images is well known in the art. It would have been obvious to one of ordinary skill in the art at the time the invention was made to align the two images by minimizing the sum of squares distance between alignment marks of the respective images as taught by Garza in order to quickly and accurately align the two images for subsequent comparison (column 4, line 10-15).

Conclusion

29. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. USPN 5,331,370 to Rosner et al. discloses a method and apparatus for determining a feature-forming variant of a lithographic system including selecting materials and process parameters for fabricating a pattern. USPN 6,373,975 to Bula et al. discloses error checking of simulated printed images including process window effects and producing images representing different manufacturing qualities. USPN 6,701,004 to Shykind et al. discloses detecting defects on photomasks wherein different conditions such as length of exposure time and optical focus are configured to highlight and detect defects.

30. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO

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MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ryan J Hesseltine whose telephone number is 703-306-4069. The examiner can normally be reached on Monday - Friday, 8:30 AM - 5 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amelia Au can be reached on 703-308-6604. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Ryan J. Hesseltine
May 7, 2004

JINGGE WU
PRIMARY EXAMINER

